Chapter 10. South Lahontan Hydrologic Region

Setting

Although the South Lahontan hydrologic region brings to mind images of desert with Joshua trees, sand dunes, and dry lakes, it also contains the glacier-carved Eastern Sierra and the eastern slopes of the San Gabriel and San Bernardino Mountains. The northern half of the region includes Owens Valley, Panamint Valley, Death Valley, and the Amargosa River Valley. Occupying roughly the southern half of the region, the Mojave Desert is characterized by numerous small mountain ranges and many basins of varying sizes. (if we don't have space to identify them by name, we shouldn't allude to them) The region includes all of Inyo County and parts of Mono, San Bernardino, Kern, and Los Angeles Counties (Figure 10-1).

Notable streams and rivers are few in the South Lahontan Region. Owens River is probably the best known. Flowing the length of Owens Valley and fed from the slopes of the Sierras and White Mountains, the once substantial stream cut its way to Owens Lake until most of its flow was intercepted for use in Los Angeles after 1913. Another important river in the region is the Mojave River. Although seldom seen flowing on the earth's surface, its' primarily underground flow supports nearly all the groundwater-supplied agriculture and urban population in the Mojave River Valley. There is one dam on the Mojave River at the base of the San Bernardino Mountains--Mojave River Forks Dam. This USACE flood control facility provides a maximum reservoir storage capacity of 179,400 acre-feet. Does this foregoing dam report belong here? The Amargosa River is the only other significant river in the region. However, the Amargosa does not serve any agriculture and is ephemeral for most of its length.

Climate

The South Lahontan region is a relatively dry one. Annual average precipitation is less than 10 inches, except for the higher mountains. Annual average precipitation in the Sierra ranges from 25 to 50 inches, which can translate to many feet of snow accumulation. Some of the central and eastern portions of the Mojave Desert average only 4 inches annually. Death Valley receives a little less than 2 inches on the average, but just a few tenths of an inch falls in some years. Daytime temperatures in the winter are generally mild, but hot in the summer. (already mentioned)

Death Valley experiences oven-hot environment in the summer, when daytime maxima routinely reach the 110s and low 120s. Most seasons even see a few searing days with temperatures reaching the middle and upper 120s. A reading of 134 degrees was attained on a July day in 1913, the record for the western hemisphere.

Population

Although the region is the largest in the State, its 2000 population was about 709,000, only 2 percent of California's population.Nearly 450,000 of them live in the Antelope, Apple, and Victor Valleys. The Cities of Palmdale and Lancaster were among the fastest-growing ones in the State in the 1990s.

Land Use

Although much of the region's land is under some kind of protected or managed status for recreational, scenic, environmental, and military reasons, the region has significant agricultural acreage and several growing cities. Even though 18,000 acres in the Antelope Valley remain agriculturally productive, it and

Victor Valley have to really be considered an urban realm today. Outside of these valleys and the Cities of Barstow and Ridgecrest, the region is rural with small towns and hamlets of less than 8,000 population standing many miles apart. The region's 65,000 acres of irrigated crops are mainly planted to alfalfa, pasture, and truck and vegetable crops. Most agricultural land is located in the Antelope Valley, along the Mojave River, and in the Mono-Owens area (I thought we were to avoid using PSA identifiers. I believe the "Mono-Owens area" can be used because it is a recognized regional identifier, independent of DWR classification. Alfalfa and pasture grass make up approximately 75 percent of the agricultural acres in the Region, while truck crops (mostly carrots and onions) represent approximately 12 percent.

Water Supplies and Use

The Los Angeles Aqueduct is the region's major water development feature. In 1913, the 223-mile-long, first pipeline of LAA was completed and began conveying water from Owens Valley to the City of Los Angeles Aqueduct was extended 115 miles north into the Mono Basin and diversions began in 1940. A second, 137-mile-long pipeline was completed in 1970.

There are eight reservoirs in the Los Angeles Aqueduct system with a combined storage capacity of about 323 taf. These reservoirs were constructed to store and regulate flows in the aqueduct. The northernmost reservoir is Grant Lake in Mono County. Six of the eight reservoirs are located in the South Lahontan Region. Bouquet and Los Angeles Reservoirs are in the South Coast Region. Water from the aqueduct system passes through 12 power plants on its way to Los Angeles. The annual energy generated is more than 1 billion kWh, enough to supply the needs of 220,000 homes.

Groundwater provides nearly half of the annual water supply in the region. Groundwater is used conjunctively with surface water in the more heavily pumped basins. Seventy-six groundwater basins underlie about 55 percent of the hydrologic region and groundwater storage capacity is estimated for 49 of these basins (DWR 2003). The estimated storage capacity is about 232 million af. Most of the groundwater production is concentrated, along with the population, in basins in the southern and western parts of this hydrologic region. Because much of this hydrologic region is public land with low population density, there has been little groundwater use and little is known about the groundwater in many of the basins.

Five water agencies have contracts with the State Water Project for a total of about 250 taf annually. The East Branch of the SWP California Aqueduct brings imported water into the region. Some of the SWP water is used to recharge groundwater in the Mojave River Valley. Mojave Water Agency (MWA) has taken little of its SWP amount to date, primarily because of financial considerations.

Antelope Valley-East Kern Water Agency, the largest SWP contractor in the region and the third largest in the State, serves five major and 16 small municipal agencies, as well as Edwards AFB, Palmdale Air Force Plant 42, and U.S. Borax and Chemical Facilities. AVEK was formed to bring imported water into the area.

The 2.7 taf capacity Littlerock Reservoir provides water supply to Littlerock Creek Irrigation District and to Palmdale Water District. PWD funded most of a seismic rehabilitation of the 1924-vintage dam in exchange for control of the water supply for 50 years. Water from Littlerock Reservoir is released into a ditch that conveys flows to PWD's Lake Palmdale, a 4.2-taf storage reservoir.

In the San Bernardino Mountains, Lake Arrowhead, owned by the Arrowhead Lake Association, is a 48 taf reservoir providing recreational opportunities and water supply for Arrowhead Woods property owners.

Mojave River Adjudication

The Mojave River Groundwater basin has experienced overdraft since the early 1950s, with the largest increase in overdraft in the 1980s. The Superior Court's final ruling on basin adjudication was issued in January 1996. In its ruling, the Court emphasized that the area has been in overdraft for decades and that MWA must alleviate overdraft through conservation and purchase of supplemental water. MWA was appointed as the basin watermaster. Some non-stipulating parties challenged the Stipulated Judgment and the case was eventually heard by the California Supreme Court in August of 2000. The higher court affirmed the Stipulated Judgment as to the parties, but determined that some of the appellants held overlying water rights that are not subject to the Judgment. Consequently, the Judgment continues to be implemented in the Mojave Basin Area.

The adjudication stipulated that any party pumping more than 10 af/yr became a party to the Judgment and is bound by it. The Judgment stated that each party has a right to its base annual production, which was its highest usage between 1986 and 1990. The Judgment also required Watermaster to initially reduce this amount by at least 5 percent each year for four years as one way to achieve a physical solution to the longstanding overdraft. Any party exceeding its annual allotment must purchase replenishment water from MWA or from other parties to the Judgment. If there is still overdraft after the end of the first five years of the Judgment, water use in overdrafted subareas will be further reduced. The Judgment recognized five basin subareas and required that if an upstream subarea does not meet its obligation to a downstream subarea, the upstream area must pay for supplemental water.

The Town of Mammoth Lakes serves surface and groundwater to a permanent population of only about 5,000, an average daily population of about 13,000, and a peak weekend and holiday period population up to 30,000 per day. Most environmental water demands involve the restoration of the water surface elevation of Mono Lake and releases into the Owens River that were intercepted for use in Los Angeles after 1913. The other important river in the region is the Mojave River. Although seldom seen flowing on the earth's surface, its' primarily underground flow supports nearly all the groundwater-supplied agriculture and urban population in the Mojave River Valley.

Alfalfa produced in the region uses groundwater as the primary irrigation source. In the Mono-Owens PA, water supplies from the Los Angeles Aqueduct are used in the flood irrigation of improved native pasture grass fields. Ground and surface water is not the only source of water available to grow alfalfa. In the Antelope Valley region of Los Angeles County, 680 acres of alfalfa have been irrigated for the last fourteen years with municipal effluent. The treated water comes from the Lancaster Water Reclamation Plant owned and operated by the County Sanitation District No. 14 of Los Angeles County.

The following water balance table summarizes the detailed regional water accounting contained in the water portfolio at the end of this regional description. As shown in the table, exports from the region far exceed the consumptive uses within the region.

State of the Region

Challenges

Many parts of the region commonly experience shortfalls in water supplies. For example, a study by the Antelope Valley Water Group concluded that the valley's existing and future water supply reliability from groundwater, the SWP, Littlerock Reservoir, and recycling is low and that full 1998 water demands would be met only half the time without overdrafting groundwater resources. Meeting water demands for projected growth and development is a concern for many water agencies. Overdrafting groundwater resources can also dry up watering holes needed by wildlife.

Surface water quality is excellent in the region, greatly influenced by snowmelt from the eastern Sierra Nevadas. At lower elevations, though, water quality can be degraded, both naturally (from geothermal activity) and anthropogenically (e.g. recreation, grazing). Nutrients entering Crowley Reservoir have contributed to low dissolved oxygen levels in reservoir releases, resulting in fish kills downstream. Water quality and quantity are inherently related in the Owens River watershed due to the large exports of surface and groundwater to the City of Los Angeles. Arsenic, a known human carcinogen, is a health concern in the basin, and therefore, in Los Angeles as well, especially with the impending lower drinking water standard. While the vast majority of public water supply wells meet drinking water standards, when these standards are exceeded, it is most often for TDS, fluoride, or boron. Several domestic water supply wells in the Barstow area have been closed due to historical contamination from industrial and domestic wastewater. Three military installations in the southwestern part of the region are on the federal Superfund National Priorities List because of volatile organic compounds and other hazardous contaminants, and the infamous PG&E chromium groundwater contamination site in Hinkley is also in this region. In its triennial review, the Lahontan Regional Board identified the need for site-specific ammonia objectives for Paiute Ponds and Amargosa Creek in Los Angeles County.

Accomplishments

The Indian Wells Valley Water District has been involved in a cooperative study and project to alleviate declining water levels and to manage water quality problems. Imported water would be used for recharge, if available. Studies are being conducted to determine where recharge would be most feasible. Additional studies will attempt to determine the age and source of deep groundwater, that has higher levels of minerals.

The region has already developed solutions to two major issues within the past 10 years. Over use of the Mojave River Valley groundwater and water diversions from the Owens River/Mono Basin by the City of Los Angeles both negatively affected the region for decades. Overdraft of the Mojave River groundwater basin since the early 1950s lead to adjudication in 1996 and the appointment of the Mojave Water Agency as the basin watermaster. The Los Angeles Department of Water and Power (LADWP) is presently involved with many restoration projects for the Owens River and Mono Basin. In 1993, LADWP began final flow releases to restore Mono Lake to a water surface elevation of 6,392 feet. By 2003, Mono Lake elevation had reached 6,382, a level where LADWP can export 16,000 acre-feet per year. LADWP has developed plans to help ranchers manage grazing practices in the Crowley Lake tributary area. The Owens Gorge Rewatering Project, and the Lower Owens River Project are two premier restoration programs being implemented by LADWP to restore the river after 50 years of dewatering. Several other restoration projects are under way.

In 1994, Mojave Water District completed its Morongo Basin pipeline, a 70-mile pipeline with a capacity of 100 cfs, from the SWP's East Branch to the Mojave River (7 miles) and then 22 cfs to Morongo Basin and Johnson Valley. This pipeline allows MWA to bring SWP water into part of its large (almost 5,000-square-mile) service area. MWA has been delivering about 3.5 taf per year to the Hi-Desert Water District since completion of the Morongo Basin Pipeline. In 1997, MWA began construction of its 71-mile Mojave River Pipeline (94 cfs capacity) to bring imported water to the Barstow area and neighboring communities downstream to the Newberry Springs area. The pipeline has been constructed a distance of approximately 61 miles to a recharge facility along the river near the community of Daggett. Recharge facilities have also been constructed along the river near the communities of Hodge and Lenwood. The final reaches of the pipeline are expected to be completed by the end of 2004 or early 2005, terminating with a recharge facility in the Newberry Springs area.

Mojave Water District has entered into a multiyear banking and exchange agreement with Solono County Water Agency. During any wet year, SCWA can bank up to 10,000 acre-feet of its annual SWP water in MWA’s groundwater basin, not to exceed a total balance of 20,000 acre-feet. During drought years, SCWA can take part of MWA’s SWP water in exchange. MWA has developed ability to store more imported supplies in the Mojave River Basin at MWA’s Rock Springs groundwater recharge facility and is considering more recharge facilities in other areas. Several other districts are considering groundwater recharge projects. Loan and grant programs, especially for drought relief, will continue to be needed in the region. Also, monitoring and cleanup of chromium in groundwater and cleanup of sites contaminated by mining wastes continue to be needed in the region.

Relationship with Other Regions

While most of Mojave Water District’s service area is within the South Lahontan Region, the service area extends into the Colorado River Hydrologic Region (Lucerne and Johnson Valleys and the Morongo Basin), which includes the Town of Yucca Valley. Part of MWA's SWP water (up to 7.2 taf) is allocated to that area.

Some imported State Water Project water is used to recharge groundwater in the Mojave River Valley basins. Surface water and groundwater are exported from the South Lahontan Hydrologic Region to the South Coast Hydrologic Region by the Los Angeles Department of Water and Power.

Looking to the Future

Many water districts have taken a proactive approach to the water reliability problems and have commenced studies and projects that could provide partial or complete solutions. These include water conservation programs, water recycling, and groundwater recovery, and water marketing and other water supply augmentation responses.

Regional Planning

Mojave Water District has initiated a demonstration project in the Oro Grande Wash south of the City of Victorville and east of Hesperia to determine the effectiveness of artificial recharge using State Water Project water. The project site is several miles from the main stem of the Mojave River and is intended to supply imported water for use by local water purveyors in an area of the Agency that is developing rapidly. This project is the first of several off-river recharge projects, that the Agency considers the next major phase in water supply infrastructure development.

MWA is currently updating its Regional Water Management Plan, which will allow it to identify and prioritize future water supply projects. The updating process began in 2002 and is expected to be concluded by 2005.

With a growing population and heavy demands on the limited supplies of fresh water for its service area, Victor Valley Wastewater Reclamation Authority (VVWRA) is planning an ambitious program in which it intends to add facilities that would recycle millions of gallons of wastewater daily. In 1997, the VVWRA completed a feasibility study that projected population growth and wastewater treatment requirements, identified potential reclamation strategies and costs through 2020. The strategies included potential uses of fully-treated effluent for beneficial uses such as landscape irrigation, industrial process water, and other purposes. In 2000, VVWRA adopted amendments to the plan, which projected future wastewater flows in the service area with greater accuracy. In 2002, another amendment was adopted that recommended the development of four sub-regional reclamation facilities by the year 2010. The current wastewater flows of 9 MGD from more than 100,000 residents and numerous businesses are expected to increase to more than 18.7 MGD by the year 2020. Also in 2002, VVWRA completed expansion of its treatment plant to accommodate flows of up to 11 million gallons per day. Financing for the project came from a zero-interest State Revolving Loan approved by the State Water Resources Control Board.

The Antelope Valley Water Group was formed in 1991 to provide coordination among valley water agencies and other interested entities. AVWG members include the Cities of Palmdale and Lancaster, Edwards AFB, AVEK, Antelope Valley United Water Purveyors Association, Los Angeles County Waterworks Districts, PWD, Rosamond Community Services District, and Los Angeles County. AVWG completed an Antelope Valley water resources study in 1995 to address regional water management issues.

The study evaluated the valley's existing and future water supplies from groundwater, the SWP, Littlerock Reservoir, and recycling, and compared these supplies with projected water demands. The study concluded that water supply reliability is low in the study area--full 1998 demands would be met only half the time without overdrafting groundwater resources. The study recommended water conservation, recycling, and conjunctive use measures to reduce expected shortages. The study identified three sites (two on Amargosa Creek and one on Littlerock Creek) with high potential for groundwater recharge through spreading and identified SWP water, recycled water, and local runoff as potential recharge sources. The study also identified several potential groundwater injection sites within existing Los Angeles County Waterworks and PWD municipal wellfields. Treated SWP water was identified as a potential recharge source.

In 2001, Palmdale Water District adopted a water facilities master plan for its service area, which updated the 1996 and 1989 master plans. PWD relies on three water sources: Littlerock Reservoir, local groundwater, and SWP water. The master plan indicates PWD’s desire to maintain a capacity to obtain 40 percent of its supply from groundwater. However, because declining groundwater levels have been a local concern in the Palmdale area, it is not clear that extractions are presently within the basin’s perennial yield. Moreover, the plan indicates that existing supplies are insufficient to meet drought demands without demand reductions and that average year shortages are projected to occur by 2010.

To help meet future demands, the plan calls for the construction of up to six new wells and the equipping of four existing cased wells so they could be used to help meet potable water demands. The Draft Environmental Impact Report for the plan identified a further decline (or a continuing decline) in groundwater levels as an unavoidable impact of constructing new wells and pumping additional groundwater to maintain that source for 40 percent of PWD's supply. Mitigation measures recommended include water conservation and drought year water demand reduction, conjunctive use programs, acquisition of additional SWP Table “A” amount water (4.0 taf was added in 1999), participation in water transfers, and development of uses for recycled water.

In preparation for a future conjunctive use project, the Quartz Hill Water District drilled six wells in 2002. Only four of the wells were equipped to pump because the yield on the other two was too low. The wells are to be used for water supply. In addition, Quartz Hill plans to add injection equipment to some wells so that they can be utilized to recharge the ground water basin if surplus water supplies become available.

In 2001, the VVWRA Board of Commissioners approved a draft policy to sell recycled water at the current river discharge to stipulated parties in the Mojave Adjudication and held a public hearing on the policy. Under the policy, recycled water would be sold and credited to individual parties for use in meeting makeup water and/or replacement water obligations required by the adjudication. However, the Board tabled consideration of the proposed policy until current challenges to the Mojave Adjudication are settled by the Superior Court.

Water Portfolios for Water Years 1998 and 2000

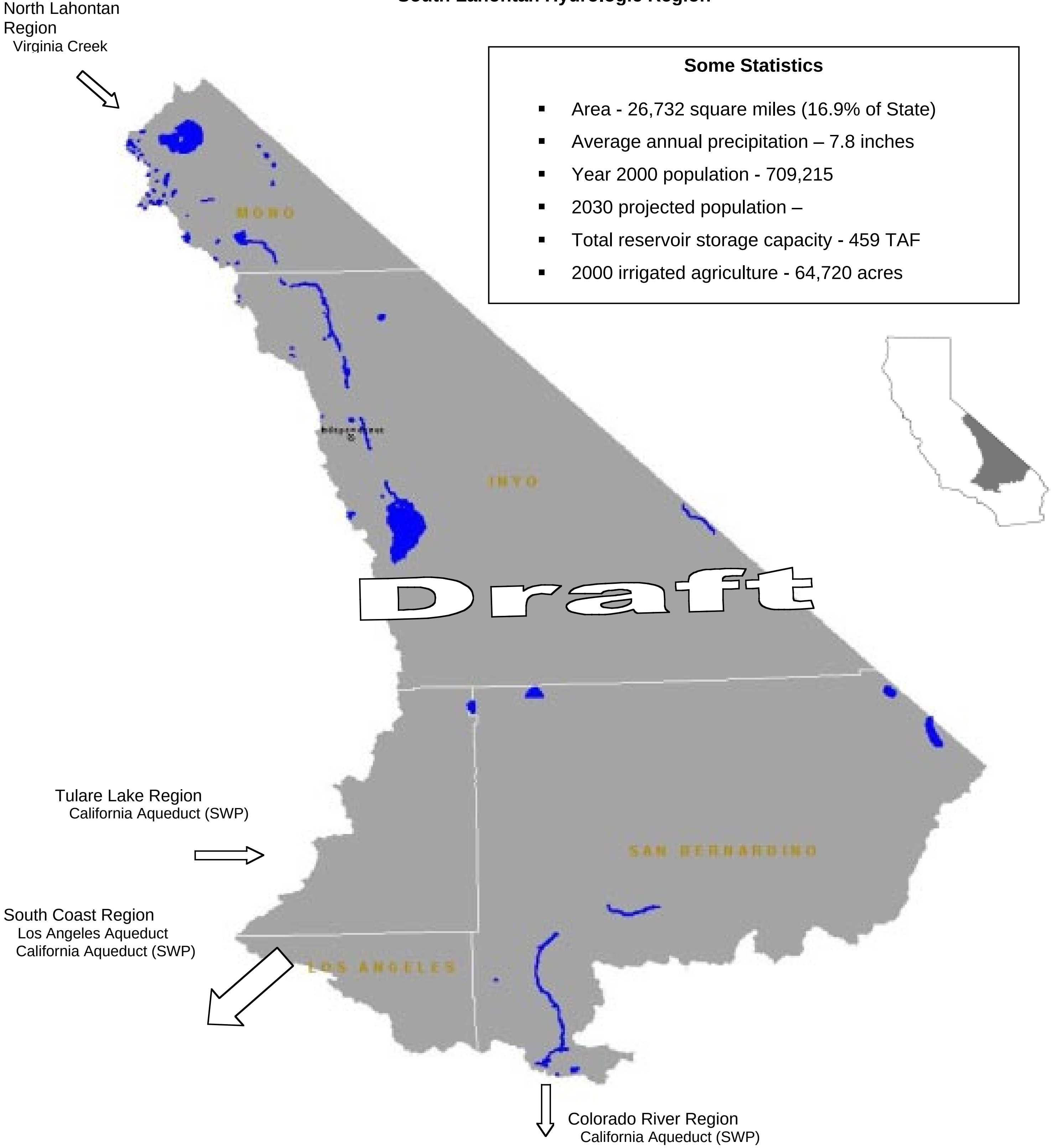
The following tables present actual information about the water supplies and uses for the South Lahontan hydrologic region. Water year 1998 was a wet year for this region, with annual precipitation at 180 percent of normal, while the statewide annual precipitation was 170 percent of average. Year 2000 represents less than normal hydrologic conditions with annual precipitation at 55 percent of average for the South Lahontan region, and year 2001 reflected normal water year conditions with annual precipitation at 100 percent of average. For comparison, statewide average precipitation in year 2001 was 75 percent of normal. Table 10-1 provides more detailed information about the total water supplies available to this region for these three specific years from precipitation, imports and groundwater, and also summarizes the uses of all of the water supplies. The three Water portfolio tables included in Table 10-2 and companion Water Portfolio flow diagrams (Figures 10-2, 10-3 and 10-4) provided more detailed information about how the available water supplies are distributed and used throughout this region.

A more detailed tabulation of the portion of the total available water that is dedicated to urban, agricultural and environmental purposes is presented in Table 10-3. Table 10-3 also provides detailed information about the sources of the developed water supplies, which are primarily from surface water systems and include a large percentage of water imports from other regions.

Sources of Information

- Water Quality Control Plan, Regional Water Quality Control Board
- Watershed Management Initiative Chapter, Regional Water Quality Control Board
- 2002 California 305(b) Report on Water Quality, State Water Resources Control Board
- Bulletin 118 (Draft), California's Groundwater, Update 2003, Department of Water Resources
- Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, State Water Resources Control Board, California Coastal Commission, January 2000
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001

Figure 10-1
South Lahontan Hydrologic Region



Some Statistics

- Area - 26,732 square miles (16.9% of State)
- Average annual precipitation – 7.8 inches
- Year 2000 population - 709,215
- 2030 projected population –
- Total reservoir storage capacity - 459 TAF
- 2000 irrigated agriculture - 64,720 acres

Table 10-1
South Lahontan Hydrologic Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	1998 (wet)	2000 (average)	2001 (dry)
Water Entering the Region			
Precipitation	20,409	7,476	9,741
Inflow from Oregon/Mexico	0	0	0
Inflow from Colorado River	0	0	0
Imports from Other Regions	543	836	534
Total	**20,952**	**8,312**	**10,275**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	291	335	329
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	871	1,001	707
Statutory Required Outflow to Salt Sink	80	67	58
Additional Outflow to Salt Sink	118	138	126
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	19,780	7,061	9,360
Total	**21,140**	**8,602**	**10,580**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	72	-8	-1
Change in Groundwater Storage **	-260	-282	-304
Total	**-188**	**-290**	**-305**

Applied Water * (compare with Consumptive Use) * Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.	519	598	571

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

GW change in storage =
intentional recharge + deep percolation of applied water + conveyance deep percolation – withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

Table 10-2
Water Portfolios for Water Years 1998, 2000 and 2001

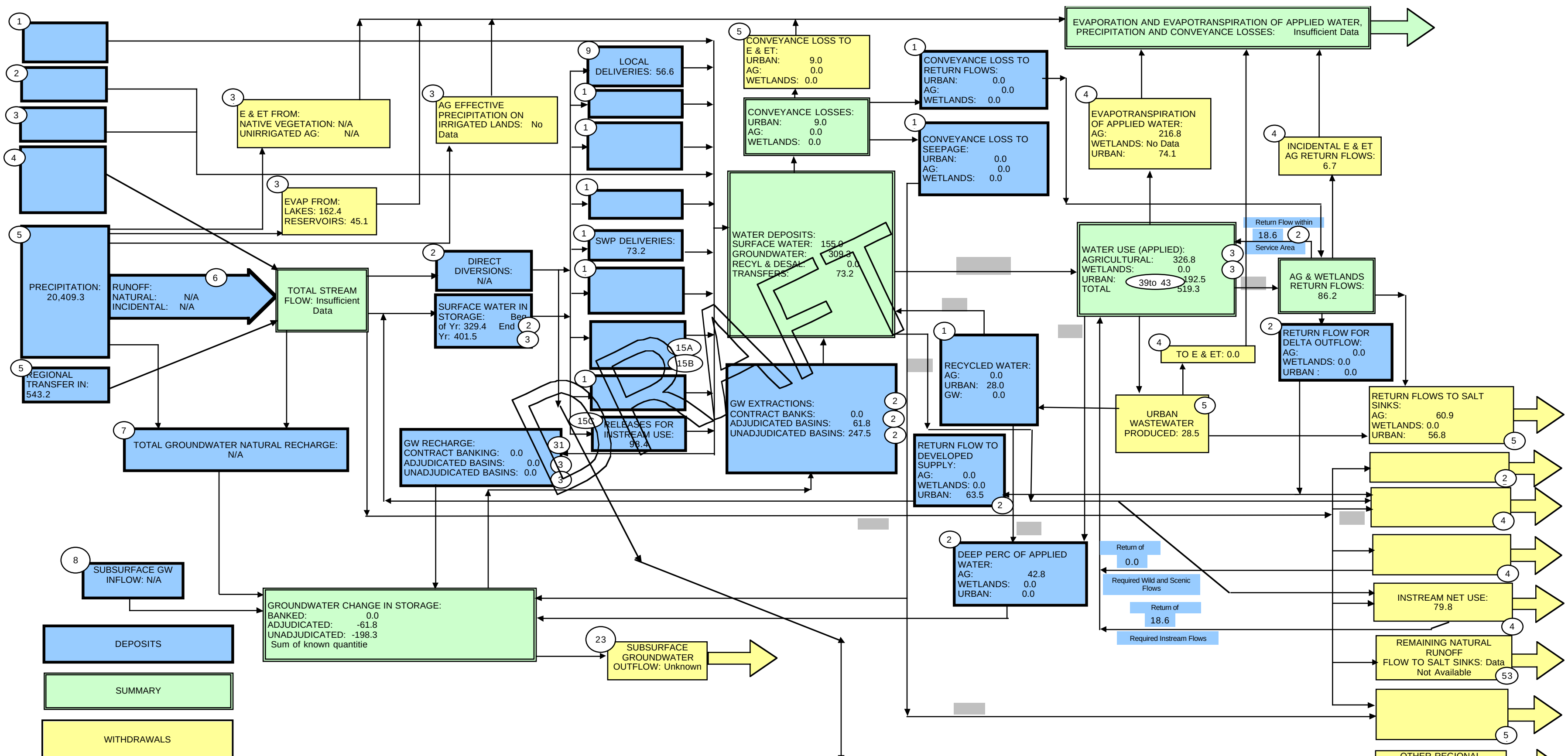
		South Lahontan 1998 (TAF)				South Lahontan 2000 (TAF)				South Lahontan 2001 (TAF)				
Category	Description	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Data Detail
Inputs:														
1	Colorado River Deliveries		-				-				-			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		-				-				-			PSA/DAU
5	Precipitation	20,409.3				7,476.1				9,740.9				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	N/A				N/A				N/A				REGION
9	Local Deliveries		56.6				58.1				46.8			PSA/DAU
10	Local Imports		-				-				-			PSA/DAU
11a	Central Valley Project :: Base Deliveries		-				-				-			PSA/DAU
b	Central Valley Project :: Project Deliveries		-				-				-			PSA/DAU
12	Other Federal Deliveries		-				-				-			PSA/DAU
13	State Water Project Deliveries		73.2				108.0				79.1			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow		98.4				88.8				78.4			REGION
16	Environmental Water Account Releases		-				-				-			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		-				-				-			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetlands		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		-				-				-			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		-				-				-			PSA/DAU
19a	Recycled Water - Agriculture		-				-				-			PSA/DAU
b	Recycled Water - Urban		28.0				29.0				29.4			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		-				-				-			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		-				-				-			PSA/DAU
c	Return Flow to Developed Supply - Urban		63.5				81.5				79.0			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		42.8				44.2				38.4			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		-				-				-			PSA/DAU
c	Deep Percolation of Applied Water - Urban		-				-				-			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		-				-				-			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		18.6				21.4				20.6			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				-			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		-				-				-			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	329.4				326.2				317.8				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	61.8				61.8				61.8				PSA/DAU
29	Groundwater Extractions - Unadjudicated	247.5				277.6				293.7				REGION
Withdrawals:	**In Thousand Acre-feet**													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	401.5				317.8				316.5				PSA/DAU
31	Groundwater Recharge-Contract Banking		-				-				-			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				162.4				163.7				163.4	REGION
b	Evaporation from Reservoirs				45.1				45.1				42.1	REGION
36	Ag Effective Precipitation on Irrigated Lands		-				-				-			REGION
37	Agricultural Use		326.8	284.0	284.4		360.9	316.7	320.4		343.9	305.5	305.5	PSA/DAU
38	Wetlands Use		-	-	-		-	-	-		-	-	-	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		66.9				98.1				94.9			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		59.2				67.8				73.8			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		11.0				23.7				12.7			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		7.2				11.6				7.2			PSA/DAU
40	Urban Commercial Use		26.0				16.8				18.1			PSA/DAU
41	Urban Industrial Use		8.2				4.8				5.5			PSA/DAU
42	Urban Large Landscape		7.7				8.0				9.0			PSA/DAU
43	Urban Energy Production		6.3				6.3				6.3			PSA/DAU
44	Instream Flow		98.4	79.8	79.8		88.8	67.4	67.4		78.4	57.8	57.8	PSA/DAU
45	Required Delta Outflow		-	-	-		-	-	-		-	-	-	PSA/DAU
46	Wild & Scenic Rivers Use		-	-	-		-	-	-		-	-	-	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				216.8				247.6				239.1	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				-				-				-	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				74.1				87.4				90.1	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				-				-				-	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				6.7				7.3				6.7	PSA/DAU
50	Urban Waste Water Produced	28.5				35.3				33.3				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				9.0				10.5				10.1	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				-				-				-	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				-				-				-	PSA/DAU
d	Conveyance Loss to Mexico				-				-				-	PSA/DAU
52a	Return Flows to Salt Sink - Ag				60.9				65.5				59.7	PSA/DAU
b	Return Flows to Salt Sink - Urban				56.8				72.0				66.7	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				-				-				-	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				79.8				67.4				57.8	REGION
54a	Outflow to Nevada				-				-				-	REGION
b	Outflow to Oregon				-				-				-	REGION
c	Outflow to Mexico				-				-				-	REGION
55	Regional Imports	543.2				836.1				533.9				REGION
56	Regional Exports	871.2				1,000.5				706.6				REGION
59	Groundwater Net Change in Storage	-260.1				-282.3				-303.5				REGION
60	Surface Water Net Change in Storage	72.1				-8.4				-1.3				REGION
61	Surface Water Total Available Storage	458.9				458.9				458.9				REGION

Colored spaces are where data belongs. N/A Data Not Available "-" Data Not Applicable "0" Null value

Table 10-3
South Lahontan Hydrologic Region Water Use and Distribution of Dedicated Supplied

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	7.7			8.0			9.0		
Commercial	26.0			16.8			18.1		
Industrial	8.2			4.8			5.5		
Energy Production	6.3			6.3			6.3		
Residential - Interior	77.9			121.8			107.5		
Residential - Exterior	66.4			79.4			81.1		
Evapotranspiration of Applied Water		74.1	74.1		87.4	87.4		90.1	90.1
Irrecoverable Losses		29.0	29.0		38.6	38.6		34.8	34.8
Outflow		31.3	31.3		37.5	37.5		35.8	35.8
Conveyance Losses - Applied Water	4.9			5.1			4.8		
Conveyance Losses - Evaporation		4.9	4.9		5.1	5.1		4.8	4.8
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
GW Recharge Applied Water	6.4			12.9			13.6		
GW Recharge Evap + Evapotranspiration		0.6	0.6		1.3	1.3		1.4	1.4
Total Urban Use	**203.8**	**139.9**	**139.9**	**255.1**	**169.9**	**169.9**	**245.9**	**166.9**	**166.9**
Agriculture									
On-Farm Applied Water	326.8			360.9			343.9		
Evapotranspiration of Applied Water		216.8	216.8		247.6	247.6		239.1	239.1
Irrecoverable Losses		6.7	6.7		7.3	7.3		6.7	6.7
Outflow		60.9	60.9		65.5	65.5		59.7	59.7
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**326.8**	**284.4**	**284.4**	**360.9**	**320.4**	**320.4**	**343.9**	**305.5**	**305.5**
Environmental									
Instream									
Applied Water	98.4			88.8			78.4		
Outflow		79.8	79.8		67.4	67.4		57.8	57.8
Wild & Scenic									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Managed Wetlands									
Habitat Applied Water	0.0			0.0			0.0		
Evapotranspiration of Applied Water		0.0	0.0		0.0	0.0		0.0	0.0
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Total Managed Wetlands Use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Environmental Use	**98.4**	**79.8**	**79.8**	**88.8**	**67.4**	**67.4**	**78.4**	**57.8**	**57.8**
TOTAL USE AND LOSSES	**629.0**	**504.1**	**504.1**	**704.8**	**557.7**	**557.7**	**668.2**	**530.2**	**530.2**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	56.6	56.6	56.6	58.1	58.1	58.1	46.8	46.8	46.8
Local Imported Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colorado River Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CVP Base and Project Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Federal Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP Deliveries	73.2	73.2	73.2	108.0	108.0	108.0	79.1	79.1	79.1
Required Environmental Instream Flow	79.8	79.8	79.8	67.4	67.4	67.4	57.8	57.8	57.8
Groundwater									
Net Withdrawal	266.5	266.5	266.5	295.2	295.2	295.2	317.1	317.1	317.1
Artificial Recharge	0.0			0.0			0.0		
Deep Percolation	42.8			44.2			38.4		
Reuse/Recycle									
Reuse Surface Water	82.1			102.9			99.6		
Recycled Water	28.0	28.0	28.0	29.0	29.0	29.0	29.4	29.4	29.4
TOTAL SUPPLIES	**629.0**	**504.1**	**504.1**	**704.8**	**557.7**	**557.7**	**668.2**	**530.2**	**530.2**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 10-2
South Lahontan Hydrologic Region 1998 Flow Diagram
In Thousand Acre-Feet (TAF)



May 25, 2004

Figure 10-3
South Lahontan Hydrologic Region 2000 Flow Diagram
In Thousand Acre-Feet (TAF)

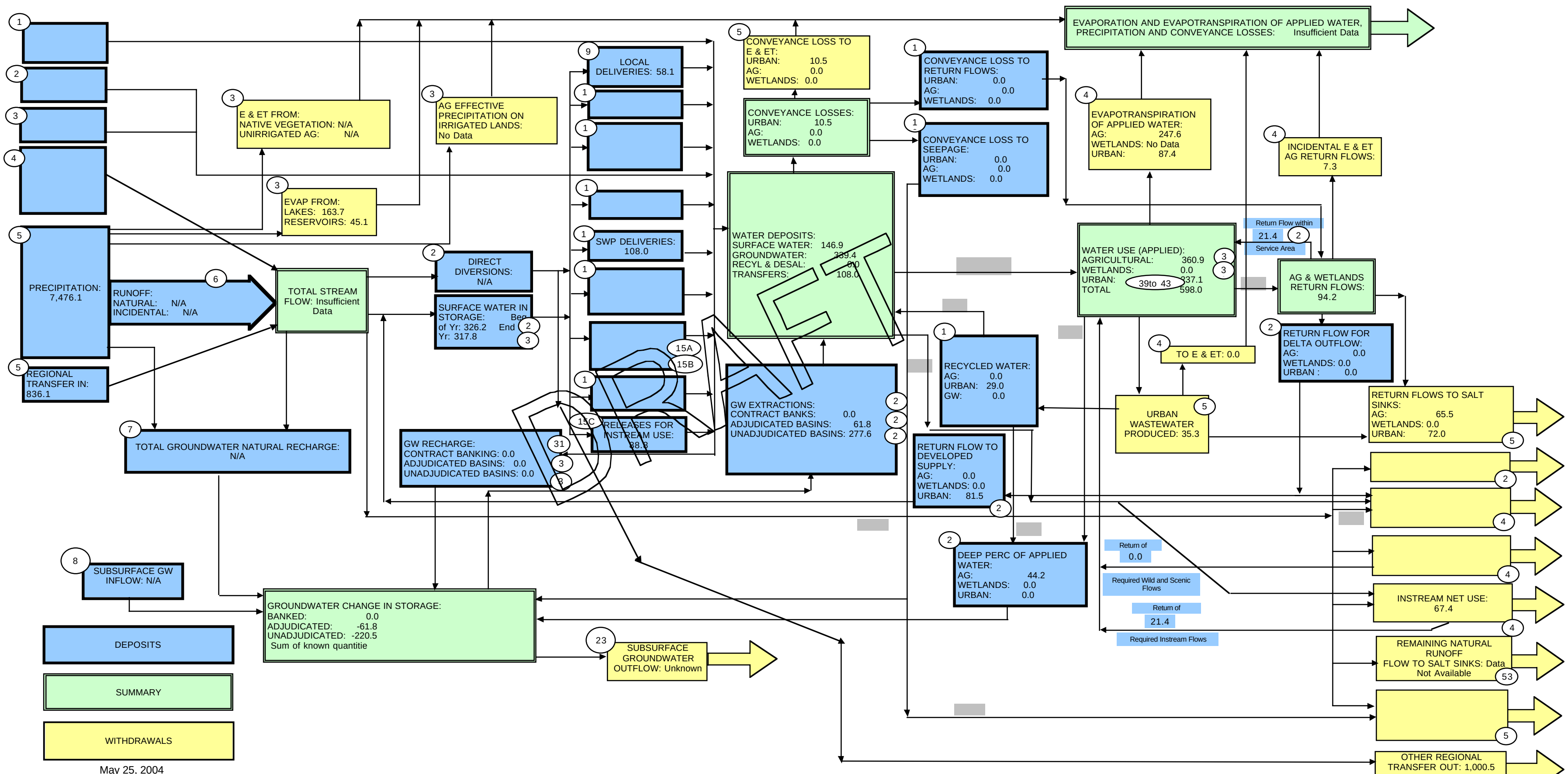


Figure 10-4
South Lahontan Hydrologic Region 2001 Flow Diagram
In Thousand Acre-Feet (TAF)